CLATHRATE HYDRATE COLD STORAGE FOR AIR CONDITIONING
Lasting Cool Breeze That Does Not Cost The Planet
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Why Storage?
- Most air conditioning systems use electricity from the grid, and are sized to meet peak cooling demand. With more systems being installed every year, enormous pressure has been put on the electricity supply network.
- Solar cooling technologies are could reduce pressure on the electricity supply network, and cut greenhouse gas emission. However, current systems have little capability to handle cooling demand when solar energy is not available (e.g. night time).

Storage is Nature’s way of Balancing Supply and Demand.
Cold storage could reduce peak demand by charging during off-peak period and discharging during peak period, it could also make solar cooling better utilised by charging when there is too much sun.

How it works?
Figure 1: Schematic for a typical configuration of an air conditioning system integrated with cold storage

In Australia, Cold storage technologies have particularly good potential for air conditioning, because:
- Building air conditioning load is one of the main causes of increase in electricity peak demand;
- The electricity supply network is expansive and costly to upgrade.

Status Quo
Over the past 20 years, commercial cold storage have in fact been used extensively in North America, Europe, and more recently in Asia. The number of HVAC cold storage installations in Australia is fairly limited.

Research Questions
1. When and where do we need cold storage?
2. What is most suitable selection/design?
3. What is the best cold storage for solar cooling?
4. How to evaluate gas hydrates, and how could they help in developing cold storage technology?

Simulation Study
The performance of various cold storage are studied incorporating electric or solar cooling system using TRNSYS simulation software, different solutions are benchmarked based on annual energy consumption, peak electric load for electric cooling system, and primary energy saving on solar cooling system.

The study target different climate in Australia using cities:
- Canberra (mild/warm summer, cold winter);
- Sydney (warm summer, cool winter);
- Brisbane (warm humid summer);
- Darwin (hot humid summer);
- Alice Spring (hot dry summer, cold winter).

Results shows that for electric cooling, All systems with storage exhibited lower peak electricity demand during grid peak hours if compared to the no-storage system clathrate storage has exhibited both high demand lopping and high energy saving potentials.

Figure 2: Ice storage system at a university campus in the U.S.

Water and ice are the most commonly used storage media, they are cheap, non-toxic, and compatible with most existing systems which require minimal retrofitting. But liquid water has inherently low energy storage density, which require larger storage to achieve required storage capacity. Ice melts and freezes at 0°C, meaning the chiller have to work under lower Coefficient of Performance (COP) when charge the storage.

Clathrate hydrates is a promising candidate that tick more boxes than other materials as storage media, but has not yet been sufficiently studied.

Figure 3: Left: R141-b clathrate hydrate produced at ANU Right: TBAB hydrate slurry produced by JFE Engineering

Figure 4: Peak load and annual energy comparisons

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